

**Chem2110 Test 2****TIME: 2 Hours**

NAME: \_\_\_\_\_ ID NUMBER: \_\_\_\_\_

<sup>1</sup> <b>H</b> 1.008													<sup>2</sup> <b>He</b> 4.003				
3 <b>Li</b> 6.941	4 <b>Be</b> 9.012																
11 <b>Na</b> 22.99	12 <b>Mg</b> 24.31																
19 <b>K</b> 39.10	20 <b>Ca</b> 40.08	21 <b>Sc</b> 44.96	22 <b>Ti</b> 47.88	23 <b>V</b> 50.94	24 <b>Cr</b> 52.00	25 <b>Mn</b> 54.94	26 <b>Fe</b> 55.85	27 <b>Co</b> 58.93	28 <b>Ni</b> 58.69	29 <b>Cu</b> 63.55	30 <b>Zn</b> 65.38	31 <b>Ga</b> 69.72	32 <b>Ge</b> 72.59	33 <b>As</b> 74.92	34 <b>Se</b> 78.96	35 <b>Br</b> 79.90	36 <b>Kr</b> 83.80
37 <b>Rb</b> 85.47	38 <b>Sr</b> 87.62	39 <b>Y</b> 88.91	40 <b>Zr</b> 91.22	41 <b>Nb</b> 92.91	42 <b>Mo</b> 95.94	43 <b>Tc</b> (98)	44 <b>Ru</b> 101.1	45 <b>Rh</b> 102.9	46 <b>Pd</b> 106.4	47 <b>Ag</b> 107.9	48 <b>Cd</b> 112.4	49 <b>In</b> 114.8	50 <b>Sn</b> 118.7	51 <b>Sb</b> 121.8	52 <b>Te</b> 127.6	53 <b>I</b> 126.9	54 <b>Xe</b> 131.3
55 <b>Cs</b> 132.9	56 <b>Ba</b> 137.3	57 <b>La*</b> 138.9	72 <b>Hf</b> 178.5	73 <b>Ta</b> 180.9	74 <b>W</b> 183.9	75 <b>Re</b> 186.2	76 <b>Os</b> 190.2	77 <b>Ir</b> 192.2	78 <b>Pt</b> 195.1	79 <b>Au</b> 197.0	80 <b>Hg</b> 200.6	81 <b>Tl</b> 204.4	82 <b>Pb</b> 207.2	83 <b>Bi</b> 209.0	84 <b>Po</b> (209)	85 <b>At</b> (210)	86 <b>Rn</b> (222)
87 <b>Fr</b> (223)	88 <b>Ra</b> 226	89 <b>Ac<sup>†</sup></b> (227)															

Question	Maximum Marks	Score
1	56	
2	40	
3	59	
<b>Total</b>	155	

### Question 1

(a) Read the following passage carefully and fill in the blanks.

(20)

A chemical bond is an electrostatic attractive force that holds atoms together. Valence electrons can be lost or gained by atoms or they can be shared between two atoms. For example, the hydrogen atom loses its electron to form a proton or it gains one electron to form a hydride ion; but two hydrogen atoms share two electrons to form a covalent bond.

The distance between the two nuclei of a hydrogen molecule is 74 pm or 0.74 Å.

This distance is called the bond length of H<sub>2</sub>(g). Half of this distance is called the covalent radius of hydrogen.

Three types of chemical bonds of compounds based on bond order are single, double and triple. Multiple bonds are stronger than single bonds because they contain π-bonding in addition to σ-bonding.

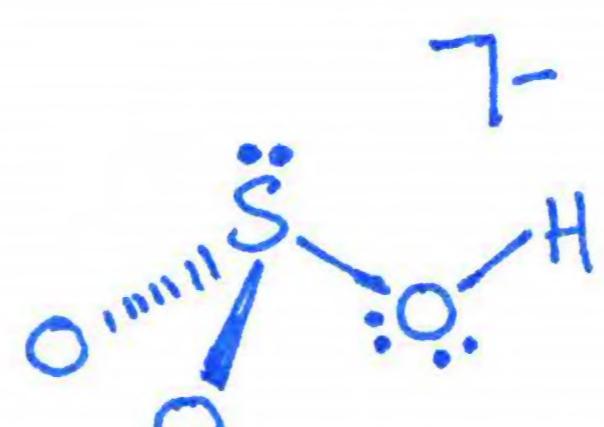
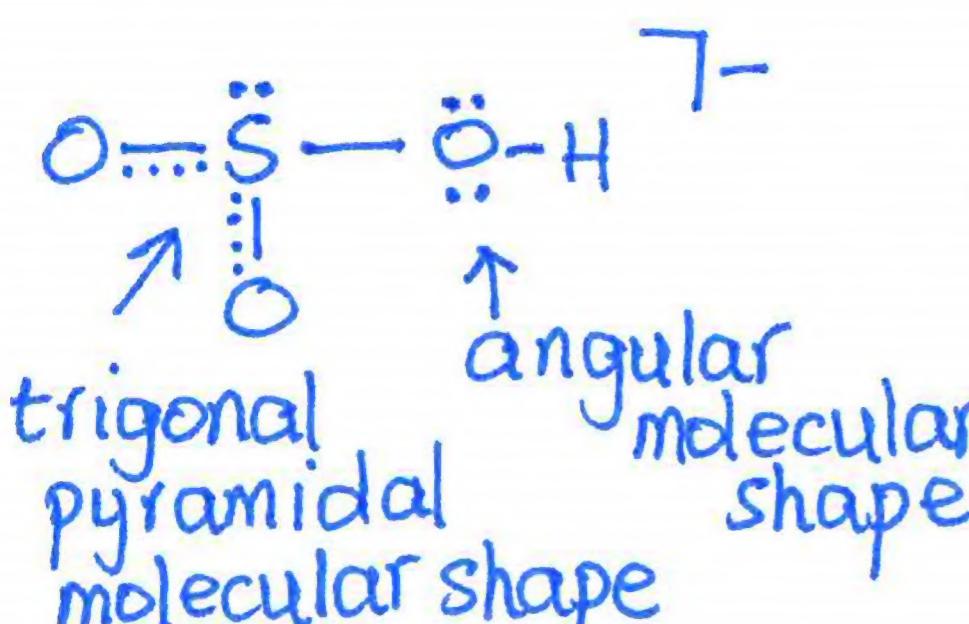
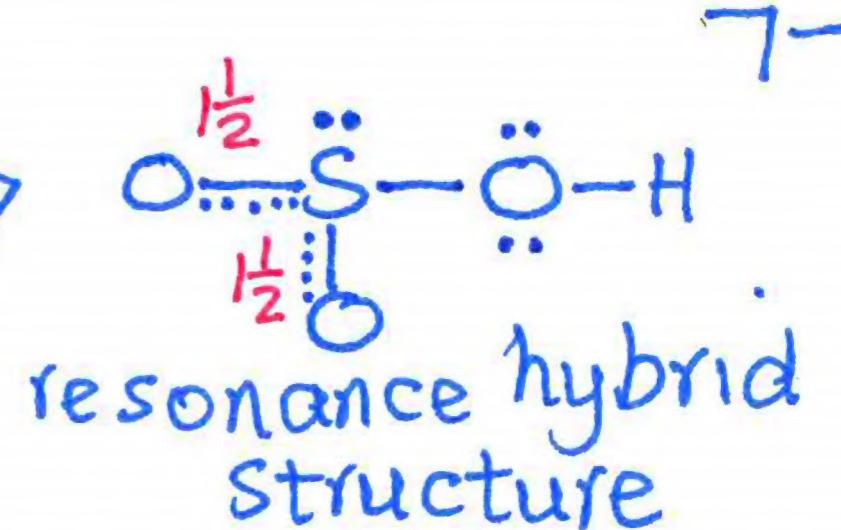
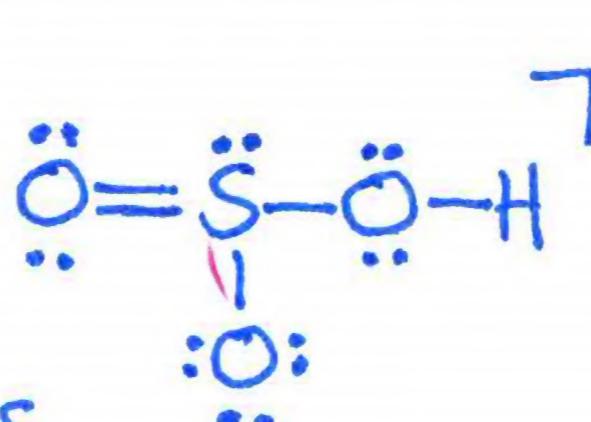
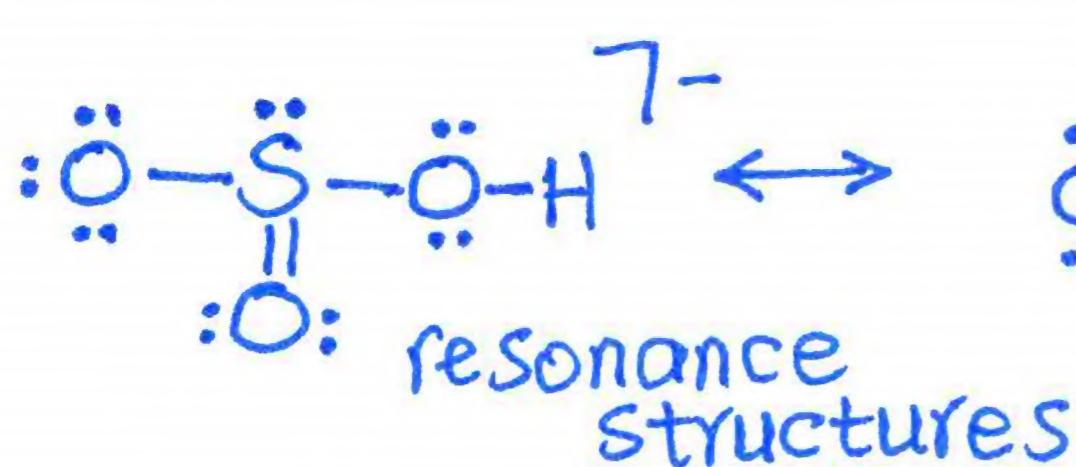
Chemical bonds can be further classified as ionic, polar covalent, and nonpolar based on the electronegativity difference between the two atoms chemically bonded together.

(b) What is the name of HSO<sub>3</sub><sup>-</sup>? Discuss below the structure of HSO<sub>3</sub><sup>-</sup>.

hydrogen sulfite ion

(8)

$$\text{HSO}_3^- \Rightarrow \text{ve} = 1 + 6 + 3(6) + 1 = 26e^- = 13e^- \text{ prs}$$



HSO<sub>3</sub><sup>-</sup> consists of two resonance structures with a bond order of  $\frac{1}{2}$  for the sulfur-oxygen bond. The S atom is sp<sup>3</sup> hybridised as is the O atom bonded to H. HSO<sub>3</sub><sup>-</sup> is a polar ion.

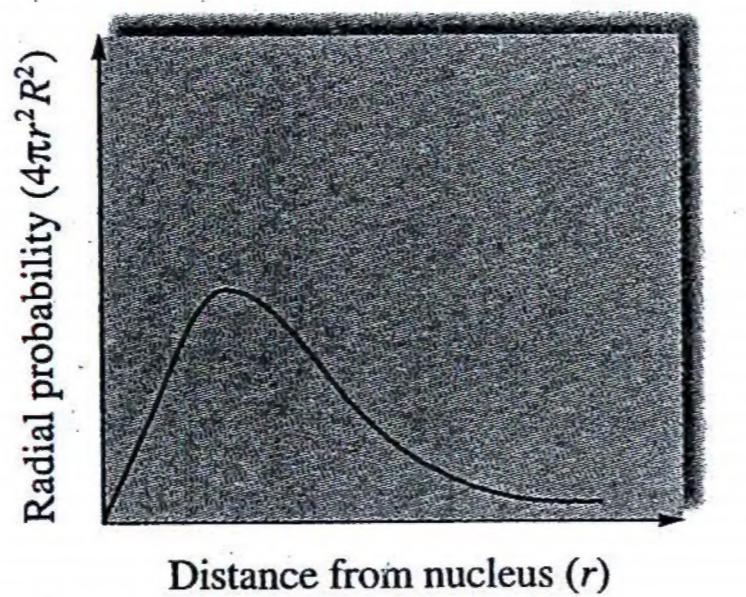
(c) Complete the following table. Where there is resonance, give all resonance structures:

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	<u>Best Lewis structure(s)</u>	<u>Molecular Shape DRAWING and NAME</u>	<u>Polar or nonpolar</u>
$\text{Ve}^- = 4 + 2(1) + 2(7) = 20 \text{e}^- = 10 \text{e}^- \text{ prs}$ Dichloromethane $\text{CH}_2\text{Cl}_2$	<u>Draw Lewis structure(s):</u> 	<u>Draw molecular shape:</u>  <u>Name(s) of molecular shape(s):</u> tetrahedral	<u>Polar or nonpolar</u>  polar
$\text{Ve}^- = 1 + 5 + 2(4) = 18 \text{e}^- = 9 \text{e}^- \text{ prs}$ Nitrous acid $\text{HNO}_2$	<u>Draw Lewis structure(s):</u> 	<u>Draw molecular shape:</u>  <u>Name(s) of molecular shape(s):</u> N ⇒ angular O ⇒ angular	<u>Polar</u> 
$\text{Ve} = 6 + 4(7) = 34 \text{e}^- = 17 \text{e}^- \text{ prs}$ Sulfur tetrafluoride $\text{SF}_4$	<u>Draw Lewis structure(s):</u> 	<u>Draw molecular shape:</u>  <u>Name(s) of molecular shapes:</u> seesaw	<u>Polar</u> 

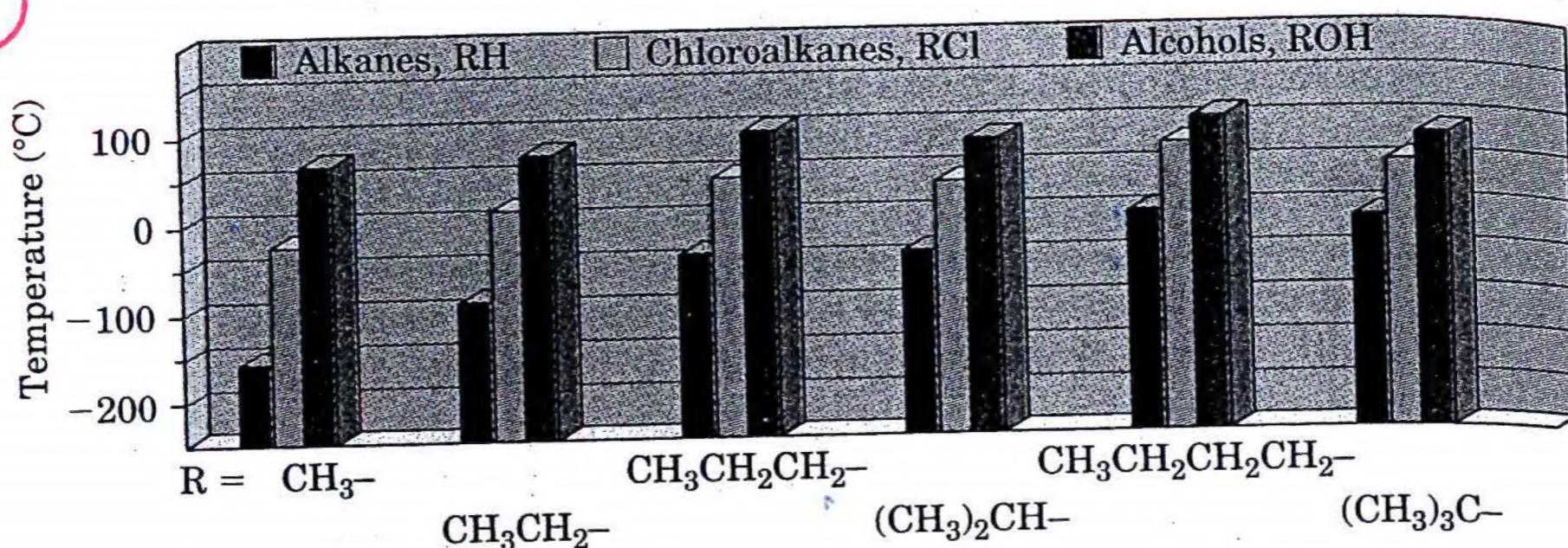
(d) Explain the following diagrams:

(i) (5)



Read your notes and the handouts

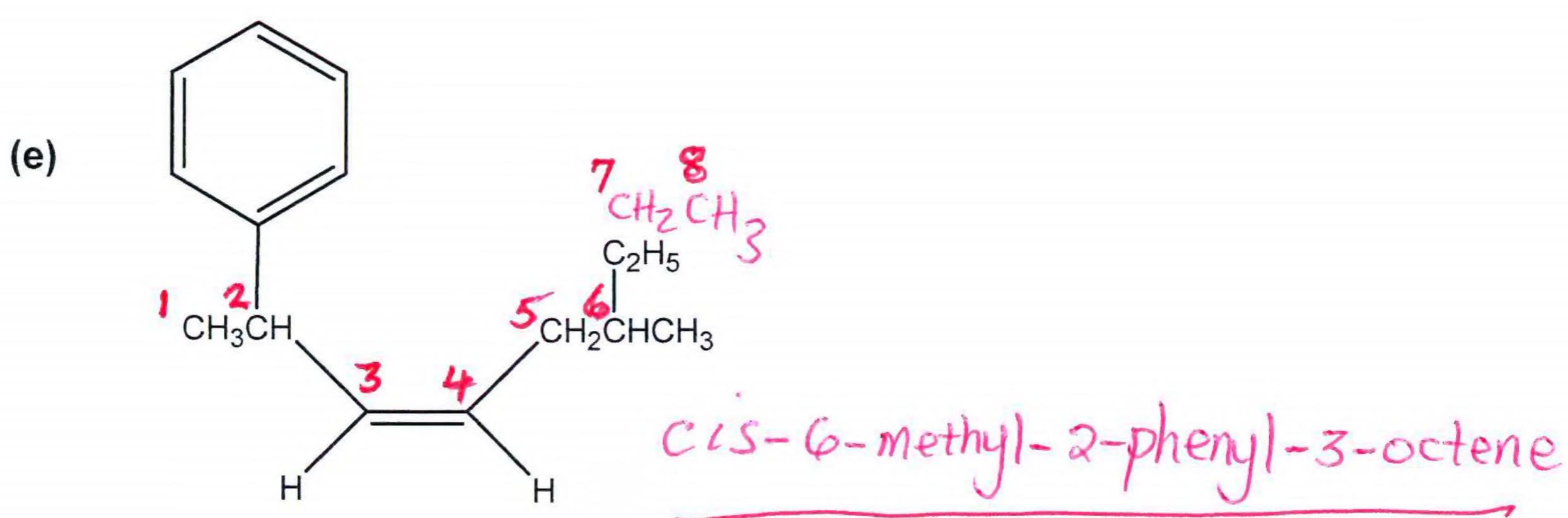
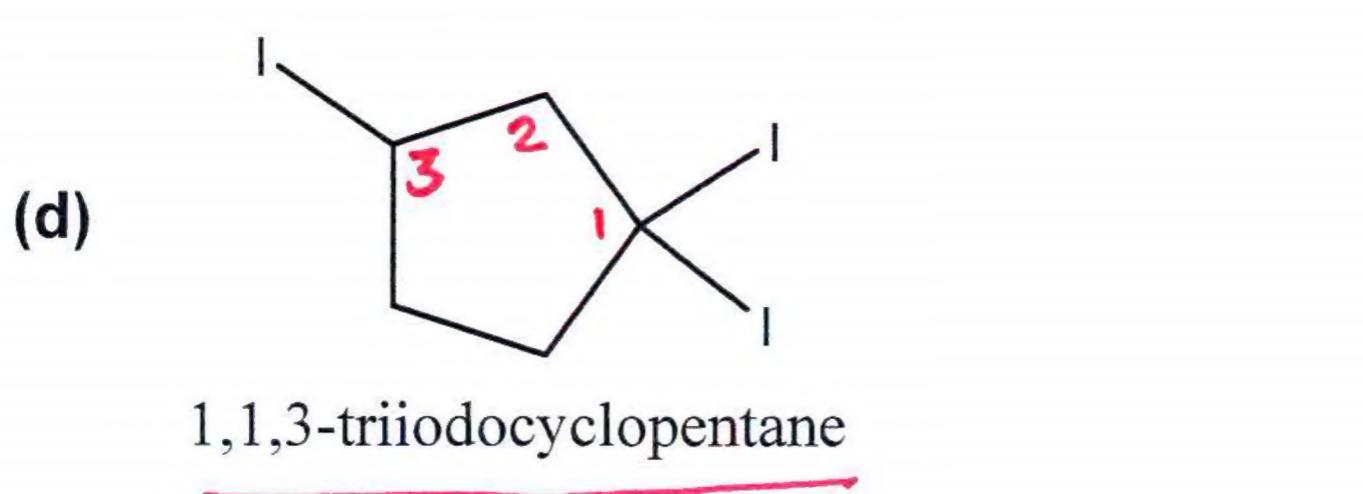
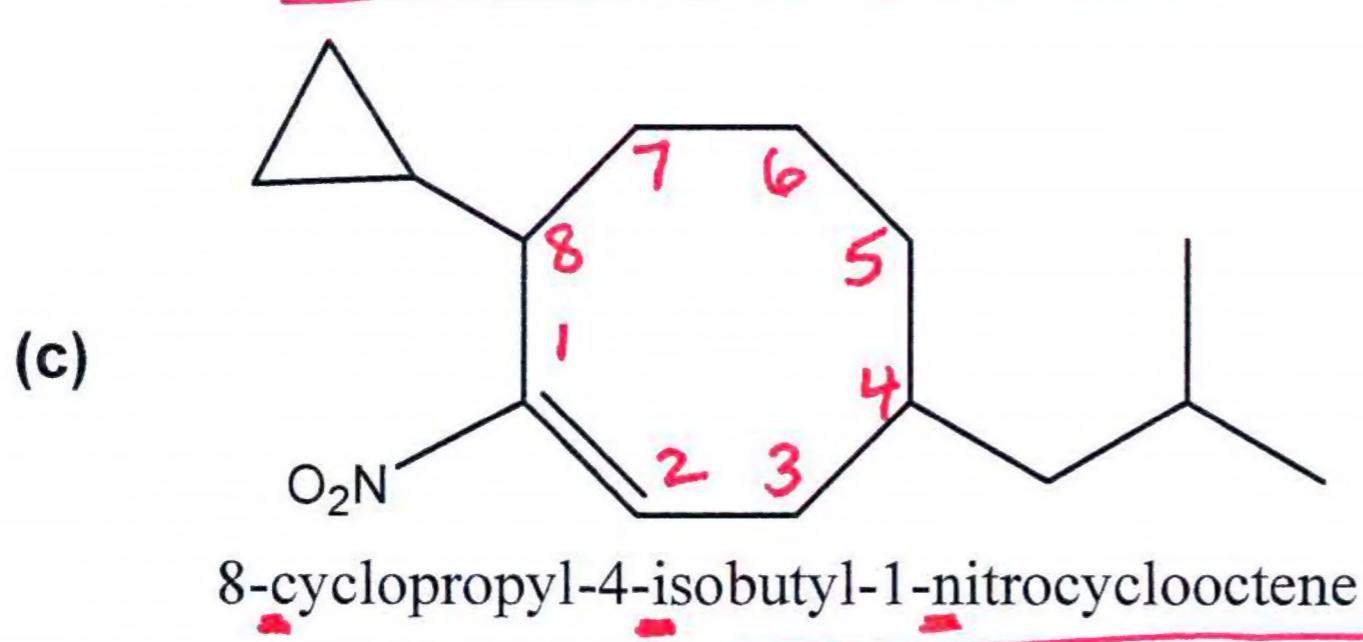
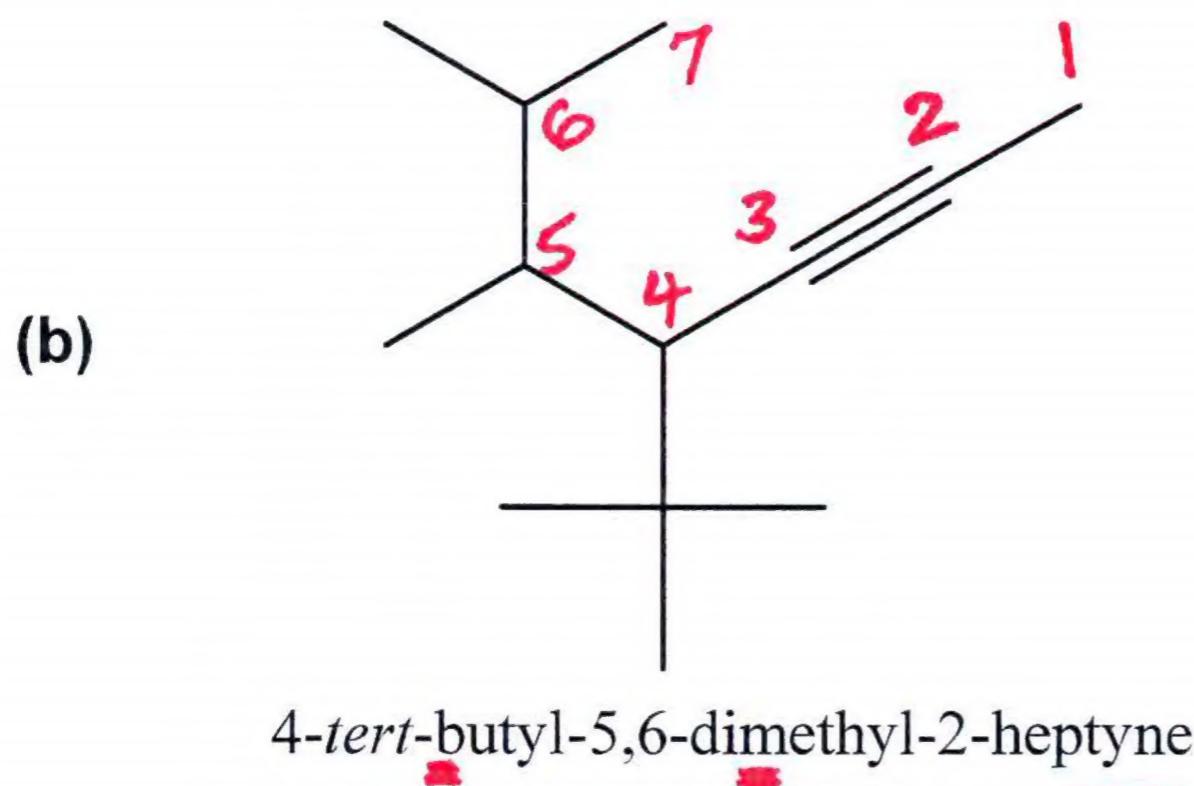
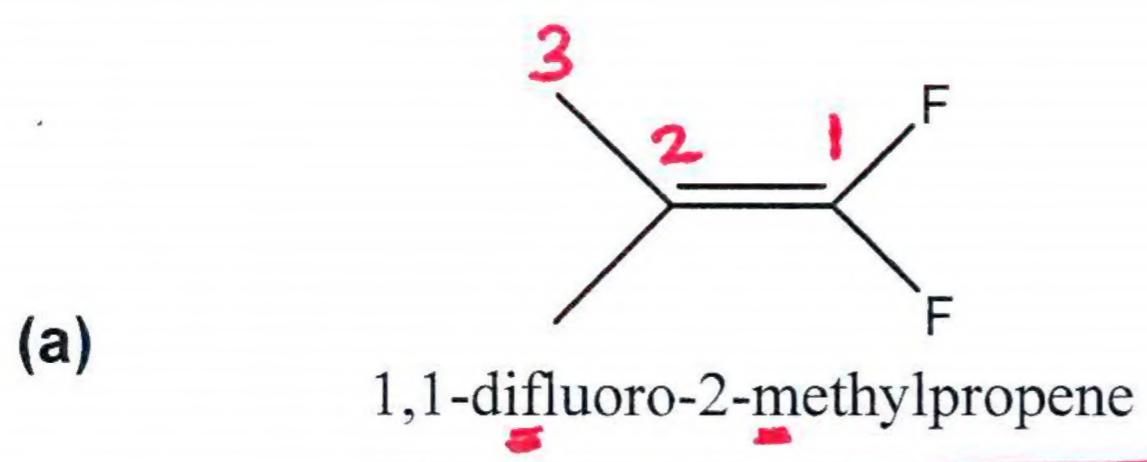
(ii) (5)



Read your notes and the handouts

Question 2

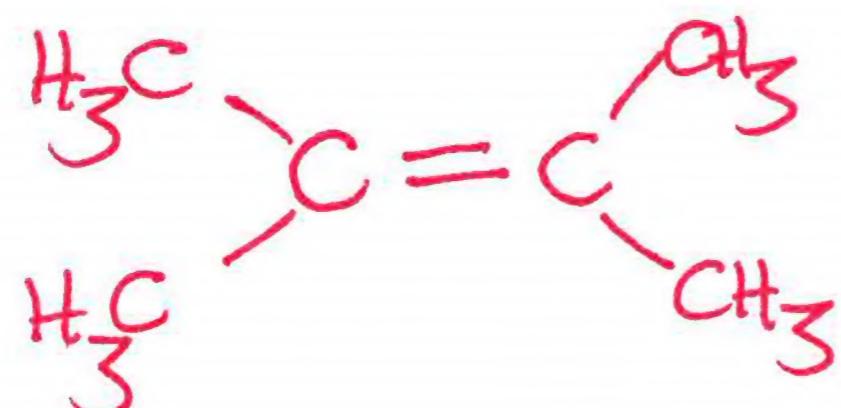
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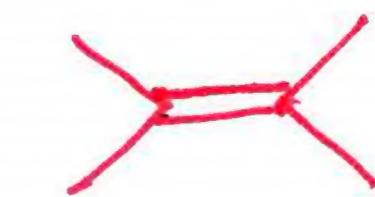
(f) Draw the structure of each of the following compounds:

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2,3-dimethyl-2-butene (line drawing)

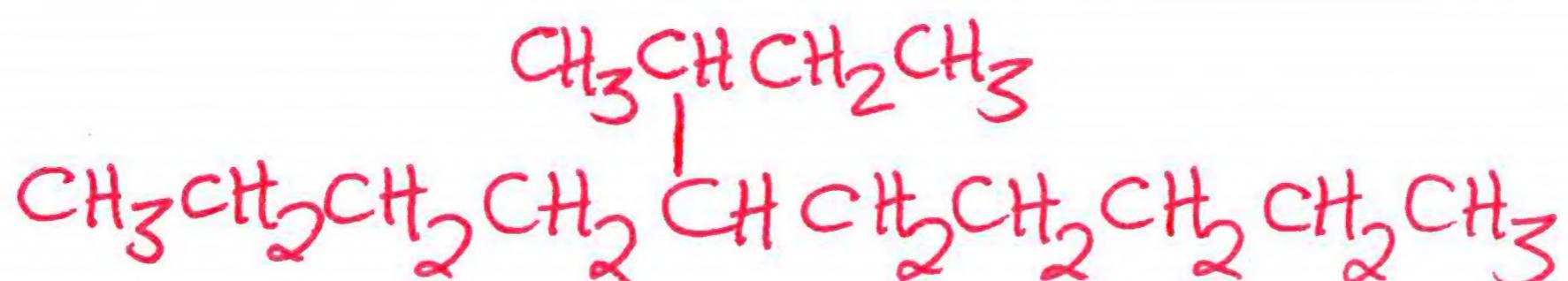


$\Rightarrow \Rightarrow$



line drawing

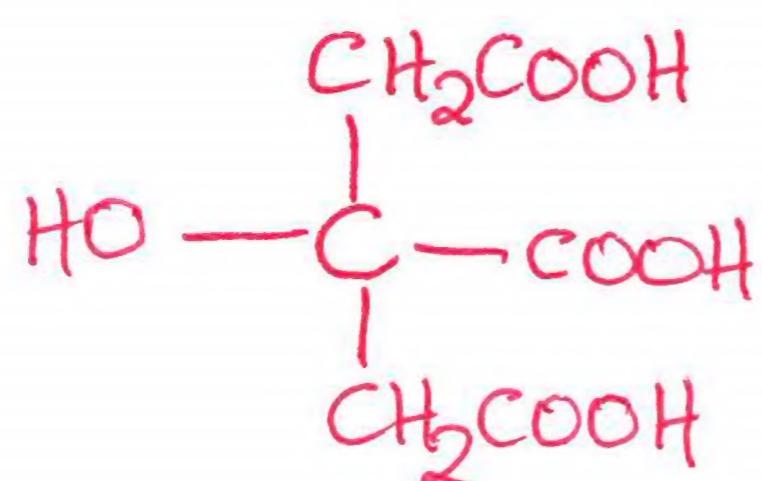
Any alkane that contains a *sec*-butyl group (condensed structural formula)



1,1-dimethylcyclohexane (chair conformation)



Citric acid



$\text{CH}_3\text{CN}$  (complete molecular shape)

